

## CLAIM(S):

1. An impact absorbing composite, the impact absorbing composite comprising:
- a plurality of impact absorbing members; and
  - a flexible layer, each impact absorbing member integral with the flexible layer.
2. The impact absorbing composite of claim 1 wherein:
- the flexible layer has internal surfaces that define a plurality of holes in the flexible layer;
  - a first polymeric material is fixed within the holes of the flexible layer;
  - the impact absorbing members comprise a second polymeric material; and
  - the first polymeric material in the holes of the flexible layer is bonded to the second polymeric material of the impact absorbing members.
3. The impact absorbing composite of claim 2 wherein:
- the flexible layer has a first major surface and a second major surface, the first major surface and the second major surface located on opposing sides of the flexible layer; and
  - the holes of the flexible layer extend through the first major surface or the second major surface.
4. The impact absorbing composite of claim 2 wherein the first polymeric material and the second polymeric material are the same.
5. The impact absorbing composite of claim 1 wherein:
- the flexible layer has internal surfaces that define a plurality of holes in the flexible layer;
  - the impact absorbing members comprise a polymeric material; and

the polymeric material of the impact absorbing members extends into and is fixed within the holes of the flexible layer.

6. The impact absorbing composite of claim 1 wherein the impact absorbing members are formed of closed cell polymeric foam.
7. The impact absorbing composite of claim 7 wherein the closed cell polymeric foam comprises polymeric material that is selected from the group consisting of polystyrene, polyethylene, polypropylene, and any combination of any of these.
8. The impact absorbing composite of claim 6 wherein the closed cell polymeric foam has a density, determined using ASTM D1622-98, that ranges from about 16 kilograms per cubic meter to about 1280 kilograms per cubic meter.
9. The impact absorbing composite of claim 1 wherein each impact absorbing member is free of voids.
10. The impact absorbing composite of claim 1 wherein adjacent impact absorbing members are discrete and individually distinct from each other.
11. The impact absorbing composite of claim 1 wherein adjacent impact absorbing members are in contact with each other.
12. The impact absorbing composite of claim 1 wherein the impact absorbing members are movable independently with respect to each other.
13. The impact absorbing composite of claim 1 wherein the impact absorbing composite is reversibly conformable to arcuate three-dimensional surfaces and to discontinuous three-dimensional surfaces.
14. The impact absorbing composite of claim 1 wherein the flexible layer is stretchable and elastic.
15. The impact absorbing composite of claim 1 wherein the flexible layer comprises a net or open-meshed fabric.
16. The impact absorbing composite of claim 1 wherein:  
the flexible layer has a first major surface;

SAB  
A2

[illegible]

the impact absorbing members are each located on the same side of the flexible layer with each impact absorbing member bonded to the first major surface;

all of the impact absorbing members collectively covering the first major surface of the flexible layer with a footprint having an area, a ratio of the area of the footprint to the area of the first major surface being at least about 80%.

17. The impact absorbing composite of claim 16 wherein the ratio of the area of the footprint to the area of the first major surface is at least about 80%.

18. The impact absorbing composite of claim 1 wherein the impact absorbing members are first impact absorbing members, the impact absorbing composite further comprising a plurality of second impact absorbing members attached in working relation with the first impact absorbing members, the first impact absorbing members and the second impact absorbing members located on opposing sides of the flexible layer.

19. The impact absorbing composite of claim 18 wherein the first impact absorbing members comprise a polymeric material and the second impact absorbing members comprise a polymeric material, the polymeric material extending continuously between first impact absorbing members and second impact absorbing members that are in registry with each other, and the polymeric material extending through the flexible layer.

20. An impact absorbing composite, the impact absorbing composite comprising:

a plurality of first impact absorbing members;

a plurality of second impact absorbing members; and

**Table 1**

Sub  
A3

Sub  
A3  
C912

a flexible layer, each first impact absorbing member and each second impact absorbing member attached to the flexible layer.

21. The impact absorbing composite of claim 20 wherein the first impact absorbing members and the second impact absorbing members are on opposing sides of the flexible layer.

22. The impact absorbing composite of claim 20 wherein each first impact absorbing member is free of voids.

23. The impact absorbing composite of claim 20 wherein adjacent first impact absorbing members are discrete and individually distinct from each other.

24. The impact absorbing composite of claim 20 wherein adjacent first impact absorbing members are in contact with each other.

25. The impact absorbing composite of claim 20 wherein the first impact absorbing members are movable independently with respect to each other.

26. The impact absorbing composite of claim 20 wherein the impact absorbing composite is reversibly conformable to arcuate three-dimensional surfaces and to discontinuous three-dimensional surfaces.

27. The impact absorbing composite of claim 20 wherein the flexible layer comprises a net or open-meshed fabric.

28. The impact absorbing composite of claim 20 wherein:  
the first impact absorbing members are formed of a polymeric material;  
the second impact absorbing members are formed of the polymeric material; and  
the polymeric material extending continuously between first impact absorbing members and second impact absorbing members that are in registry with each other on opposing sides of the flexible layer, the polymeric material extending through the flexible layer.

1. The impact absorbing composite of claim 20 wherein the first impact absorbing members are formed of a polymeric material;

Sub  
A3  
C912

29. An impact absorbing composite, the impact absorbing composite comprising:

a plurality of impact absorbing members; and  
a flexible layer, the flexible layer extending through each  
impact absorbing member and each impact  
absorbing member attached to the flexible layer.

30. The impact absorbing composite of claim 29 wherein each impact absorbing member is free of voids.

31. The impact absorbing composite of claim 29 wherein adjacent impact absorbing members are discrete and individually distinct from each other.

32. The impact absorbing composite of claim 29 wherein adjacent impact absorbing members are in contact with each other.

33. The impact absorbing composite of claim 29 wherein the impact absorbing members are movable independently with respect to each other.

34. A method of making an impact absorbing composite, the method comprising:

attaching a plurality of impact absorbing members to a flexible layer, each impact absorbing member integral with the flexible layer.

35. A method of making an impact absorbing composite, the method comprising:

attaching a plurality of first impact absorbing members to a flexible layer; and  
attaching a plurality of second impact absorbing members to a flexible layer, the first impact absorbing members and the second impact absorbing members located on opposing sides of the flexible layer.

36. A method of making an impact absorbing composite, the method comprising:

[illegible]

SWB  
AS

forming a plurality of impact absorbing members; and  
passing a flexible layer through each impact absorbing  
member; and  
attaching each impact absorbing member to the flexible  
layer.

37. A method of forming an impact absorbing composite, the  
method comprising:

placing a flexible layer into a molding apparatus, the  
molding apparatus having a plurality of first  
surfaces that define a plurality of first mold cavity  
portions and a second surface that defines a  
second mold cavity portion and, the flexible layer  
positioned between the first mold cavity portions  
and the second mold cavity portion, and the first  
mold cavity portions and the second mold cavity  
portion collectively forming a mold cavity;

placing polymeric resin in the mold cavity;

expanding the polymeric resin in the mold cavity to form  
an impact absorbing composite intermediate, the  
impact absorbing composite intermediate  
comprising expanded polymeric resin and the  
flexible layer; and

finishing the impact absorbing composite intermediate to  
form the impact absorbing composite.

38. The method of claim 37 wherein:

placing polymeric resin in the mold cavity comprises  
placing the polymeric resin in the first mold cavity  
portions and the second mold cavity portion; and  
expanding the polymeric resin in the mold cavity  
comprises expanding the polymeric resin in the first  
mold cavity portions and expanding the polymeric  
resin in the second mold cavity portion.

39. The method of claim 38 wherein:  
the flexible layer has a first major surface and a second major surface that are located on opposing sides of the flexible layer and has internal surfaces that define a plurality of holes that extend through the flexible layer from the first major surface to the second major surface; and  
placing polymeric resin in the mold cavity comprises placing the polymeric resin in the second mold cavity portion and allowing the polymeric resin to pass through the holes of the flexible layer and into the first mold cavity portions.
40. The method of claim 38 wherein the flexible layer has internal surfaces that define a plurality of holes in the flexible layer, the method further comprising securing the expanded polymeric resin within the holes of the flexible layer.
41. The method of claim 40 wherein:  
the flexible layer has a first major surface and a second major surface, the first major surface and the second major surface located on opposing sides of the flexible layer; and  
the holes of the flexible layer extend through the first major surface, through the second major surface, or through both the first major surface and the second major surface.
42. The method of claim 37 wherein the impact absorbing composite intermediate comprises a plurality of first impact absorbing members, the first impact absorbing members formed in the first mold cavity portions, and adjacent first impact absorbing members are discrete and individually distinct from each other.
43. The method of claim 42 wherein:

the flexible layer has internal surfaces that define a plurality of holes in the flexible layer;  
the first impact absorbing members comprise the expanded polymeric resin; and  
the expanded polymeric resin of the first impact absorbing members extends into and is fixed within the holes of the flexible layer.

44. The method of claim 37 wherein the expanded polymeric resin comprises closed cell polymeric foam.

45. The method of claim 44 wherein the closed cell polymeric foam comprises polymeric material that is selected from the group consisting of polystyrene, polyethylene, polypropylene, and any combination of any of these.

46. The method of claim 37 wherein the impact absorbing composite comprises:

a plurality of first impact absorbing members attached to the flexible layer; and

a plurality of second impact absorbing members attached to the flexible layer, the first impact absorbing members and the second impact absorbing members attached to opposing sides of the flexible layer.

47. The method of claim 46 wherein the first impact absorbing members are free of voids.

48. The method of claim 46 wherein adjacent first impact absorbing members are discrete and individually distinct from each other.

49. The method of claim 46 wherein the first impact absorbing members are movable independently with respect to each other.

50. The method of claim 37 wherein the flexible layer comprises a net or open-meshed fabric.



51.

The method of claim 37 wherein:  
the impact absorbing composite intermediate comprises  
a plurality of first impact absorbing members, the  
first impact absorbing members formed in the first  
mold cavity portions; and  
finishing the impact absorbing composite intermediate  
comprises:

removing excess expanded polymeric resin to form  
a plurality of second impact absorbing  
members, the first impact absorbing  
members and the second impact absorbing  
members located on opposing sides of the  
flexible layer.

52.

The method of claim 37 wherein:  
removing excess expanded polymeric resin means  
thermally cutting excess expanded polymeric resin,  
mechanically cutting or routing excess expanded  
polymeric resin, vaporizing excess expanded  
polymeric resin, or any of these in any  
combination.

A7  
A7  
7Add  
B3